Cognitive Development

Two cognitive developmental theories

- **Piaget**
  - development occurs through four **discontinuous** stages.
  - process of **assimilation** and **accommodation**
  - theory has had enormous impact, despite lacking clear theoretical entities.
  - (Biological maturation is crucial. Environment plays a secondary role)

- **Information processing theorists**
  - development is **continuous**
  - internal changes in **cognitive processing**. E.g. higher working memory capacity, better strategies and rules to solve problems
  - Clear predictions with **information processing models**

Jean Piaget

Developmental stages:

1. Sensorimotor stage
2. Preoperational stage
3. Concrete operational stage
4. Formal operational stage
Sensorimotor stage (birth – 2 years)
- Reflexive actions
- Acting to maintain or repeat interesting sensations
- Learning object permanence (mental representation)

Preoperational Stage (2 – 7 years)
- Development of representational (internal) thought
- Egocentric
- Inability to conserve
- Centration: tendency to focus on one especially noticeable aspect or dimension

Egocentrism
The child is asked to say what the doll can see. The child reports what can be seen from her perspective and not what can be seen from the doll's perspective.

Piaget & Inhelder, '48, '56
Conservation of Number

Irrelevant feature: row length

Conservation of Liquid

Distracted by physical feature of display.

Bruner: performance is better when distracting physical presence of beaker is hidden from sight
Concrete operational stage (7-11 years)

- Less egocentrism
- Learned to decenter
- Learning to conserve

Formal Operational Stage (11 – 15 years)

- Formal reasoning
- Scientific reasoning

Piaget’s Stages

- Discontinuous stages or continuous changes?

Siegler (‘96): “the myth of the immaculate transition”.

What develops?

- Neural development?
- Increased mental capacity?
- Increased knowledge?

Computer analogy. Program runs faster with:

- Better, faster computer or
- Better program on same machine?
Postnatal development of cerebral cortex

Newborn 3 months 24 months

- Neural development is a more important contributor to cognitive development before the age of two than after
- 90% of brain development is done by age 6 years

Information Processing Perspective

- Explaining cognitive development in terms of changes in cognitive processing
- These changes can be traced to physiological maturation. Higher level cognitive theories might give simple account of developmental changes
- Cognitive concepts
  - working memory capacity
  - selective attention
  - development of rules and strategies

Development of Working Memory Capacity

![Graphs showing development of working memory capacity over age.]
Selective Attention

• Zelazo experiment (also on video)

Phase 1: Shape classification. Color is irrelevant

Phase 2: Color is now important. Shape is irrelevant

Results

• Zelazo et al. (1996). How many children can master the phase 2 transfer task?
  – 40% of 3 year olds
  – 90% of 4 year olds

• 3 year olds: inability to switch attention to new dimension
  Failure to inhibit previously learned rules

• Compare with concept of centration in Piaget’s theory
Increased Mental Capacity: Development of Strategies (Case, '78)

Which pitcher will taste more strongly of orange juice?

Four strategies to solve juice mixture problems

• Some strategies can only be acquired once memory demands can be met with suitable working memory capacity

Strategy 1 (age 3-4)

#steps = 2
memory demand= 1
Strategy 2 (age 4-5)

#steps = 3
memory demand = 2

Strategy 3 (age 7-8)

#steps = 7
memory demand = 3

Strategy 4 (age 9-10)

#steps = 7
memory demand = 4
Increased Mental Capacity
Development of strategies: Siegler ’78

The balance beam problem:
Which side will go down?

Types of Problems

- BALANCE
- WEIGHT
- DISTANCE
- CONFLICT WEIGHT
- CONFLICT DISTANCE
- CONFLICT BALANCE
Aging & decline in working memory capacity

Figure 13.11 Illustration of logistic regression trials hypothesized to vary in working memory demands (top panel), and main performance of adults in their teens, twenties, and sixties with each trial type (bottom panel).

Aging and Academic Performance

Figure 13.10 Probability that a particular book will become a philosopher's best as a function of the age at which the philosopher wrote the book (adapted from Ferman, 2015).